



CARLO GAVAZZI SPACE SpA

AMS-02

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REGISTRAZIONE DELLE MODIFICHE / *CHANGE RECORD*

EDIZIONE <i>ISSUE</i>	DATA <i>DATE</i>	AUTORIZZAZIONE <i>CHANGE AUTHORITY</i>	OGGETTO DELLA MODIFICA E SEZIONI AFFETTE <i>REASON FOR CHANGE AND AFFECTED SECTIONS</i>
1	MARCH 2006		First Issue



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1. SCOPE

This document describe the test procedure applicable to the vibration test of the Flight model (FM) of the L-TOF. The objective of the test to be performed according to this procedure is :

- to measure the LTOF first frequency
- To provide a workmanship verification for the LTOF

The requirements from AD1 are:

- Lower TOF First Mode mounted > 50 Hz (Current Predicted Mode= 50.9 Hz ,First mode is a drum mode) **verified by modal test or smart hammer.**
- Lower TOF Optional Verification for mission success (Random Vibration to MWL (SVP Table 15.2) 6.8 Grms Level in X, Y, & Z axes with sine sweep test before & after)

L-TOF verification followed in this procedure, and considered satisfactory to verify the AD1 requirements, is:

- Lower TOF First Mode > 50 Hz (Current Predicted Mode for LTOF mounted on fixture= 50.49 Hz (First mode is a drum mode) **verified by frequency identification and measurement channels comparison with predictions of RD 2**
- Lower TOF Random Vibration to **MEFL (SVP Table 15.2)** axes with sine sweep test before & after (notching is foreseen)

Under the assumption that the test shall be successfully performed and:

- The measured first mode shall be > 50Hz
- The LTOF performances shall not be degraded by the MEFL environment

The LTOF shall be considered qualified and accepted for integration into the AMS02 payload considering the mechanical environment defined in AD1.

The test results shall be collected in a Test Report prepared by SERMS.

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2. DOCUMENTS

2.1 APPLICABLE DOCUMENTS

The following documents, in the valid latest issue formally agreed with the Agency, form a part of this specification to the extent specified herein. Documents referenced in the following specifications, standards, publications and procedures are also a part of this specification and are applicable to the extent specified in the text to meet the requirements of this document.

AD #	Doc Number	Issue	Date	Rev	Title
AD 1	JSC 28792,		August, 2003	Rev. C	Alpha Magnetic Spectrometer – 02 Structural Verification Plan for the Space Transportation System and the International Space Station

2.2 REFERENCE DOCUMENTS

#	Doc Number	Issue	Date	Rev	Title
RD 1	RICSYS-RP-CGS-012_Is1	1	29-06-04		L-TOF STRUCTURAL ANALYSYS REPORT
RD 2	RICH-TN-CGS-003_Is1	1	March 2006		L-TOF VIBRATION TEST PREDICTION

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3. ACRONYMS

C.I.	Configuration Item. Also called Part Number (P/N)
CGS	Carlo Gavazzi Space
CP	Control Point
ICD	Interface Control Drawing
FEM	Finite Element Method/Model
MP	Measurement Point
NA	Not Applicable
NCR	Non Conformance Report
P/N	Part Number. Also called Configuration Item C.I.
PA	Product Assurance
PVS	Procedure Variation Sheet
PSD	Power Spectral Density
QA	Quality Assurance
RV	Random Vibration
S/N	Serial Number
UUT	Unit Under Test
TOF	Time Of Flight
LTOF	Lower Time Of Flight

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4. PARTICIPANTS AND RESPONSABILITIES

The test shall be attained by (names shall be filled in the test report) :

NAME	COMPANY\INSTITUTE	ROLE	RESPONSABILITY
	INFN	Test conductor	<ul style="list-style-type: none"> - UUT transportation and integration - Support to Facility manager for integration of UUT on fixture - Test conduction - Compilation of Step by step procedure - PA\QA management
	INFN	Test Engineer	<ul style="list-style-type: none"> - Support to test conductor
	CGS	Test Enginer	<ul style="list-style-type: none"> - Support to test conductor for: <ul style="list-style-type: none"> o Instrumentation plan evaluation o vibration control quality evaluation o measurements evaluation and comparison to predictions.
	SERMS	Facility test manager	<ul style="list-style-type: none"> - Facility management and interface to Test Conductor
	SERMS	FacilityTest Engineer	<ul style="list-style-type: none"> - UUT instrumentation - Facility equipment utilization and test execution - Provision of test results

Tab. 4-1 L TOF vibration test participants and responsibility.

5. NON CONFORMANCE AND FAILURES

Any malfunction/defect which occurred during the test will be reported on the rest report.

6. CALIBRATION REQUIREMENTS

All instruments used for testing shall be calibrated.

Evidence of certification shall be provided by a label attached to the instruments itself, showing the calibration date, the expiring date and the signature of the operator.

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7. MEASUREMENT ACCURACY

Test parameter tolerances shall be as follows:

Resonance search.

sweep rate = 2 oct/min $\pm 5\%$. (1 sweep-up and down), amplitude g

High level sine vibration.

frequency: $\pm 2\%$

excitation acceleration: $\pm 0.3g$

Resonance search.

frequency: $\pm 2\%$

excitation acceleration: $\pm 0.1g$

Random vibration.

frequency: $\pm 2\%$

power spectral density:

- 20 to 500 Hz (filter bandwidth 25 Hz or narrower)

± 1.5 dB

- 500 to 2000 Hz

± 3.0 dB

- Overall g_{RMS}

± 1.5 dB

8. CONTROL ACCURACY

The transmissibility characteristic of the rigid fixture and the number of control channels used will guarantee that the controlled input vibration level is transmitted from the exciter to the unit interface without relevant amplification/degradation (less than 3dB between 5 and 500 Hz and ± 6 dB between 500 and 2000 Hz) Provided that the cumulative bandwidth that exceeds ± 3 dB, does not exceed 300 Hz) with respect to the nominal input.

No relevant discrepancies between the control signal and the different control points shall be present in case of multi-point control.

Cross talks shall not exceed the input.

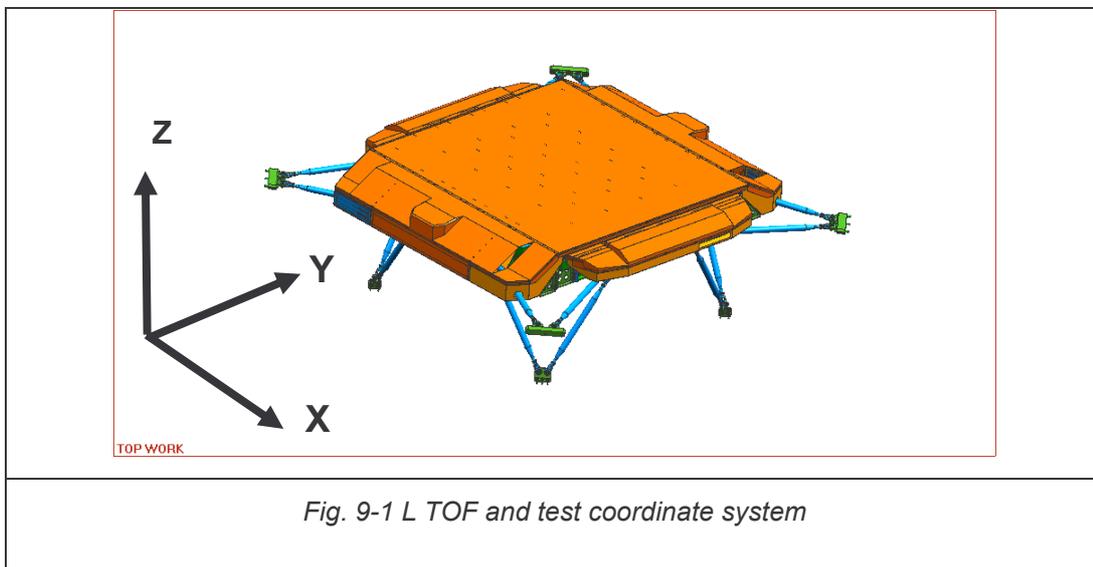
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9. TEST ARTICLE

The test article consists of the LTOF assy. The following table shall be compiled during test :

MODEL	ITEM	C.I.	Part number	S/N	NOTES
FM	L TOF ASSY				

The LTOF shall be tested without external harness during vibration.
 Following figure shows the UUT in test configuration and the test reference coordinate system.



The maximum envelope and the mass budget is presented in the following tables:

L TOF ENVELOPE	
Direction	Envelope (incl. rods) [mm]
X	2000
Y	2000
Z	710

Tab. 9-1 L TOF envelope

L TOF MASS BUDGET (TEST CONFIG.)	
ITEM	Estimated weight [kg]
Main structure	58,67
Electronics	74,97
Aerogel	13,83
TOTAL	147,47

Tab. 9-2 L TOF Mass budget

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10. TEST ARTICLE HOISTING FIXTURE AND INTEGRATION PROCEDURE

The L-TOF main part shall be lifted from the transport container using the tool showed in the next picture.

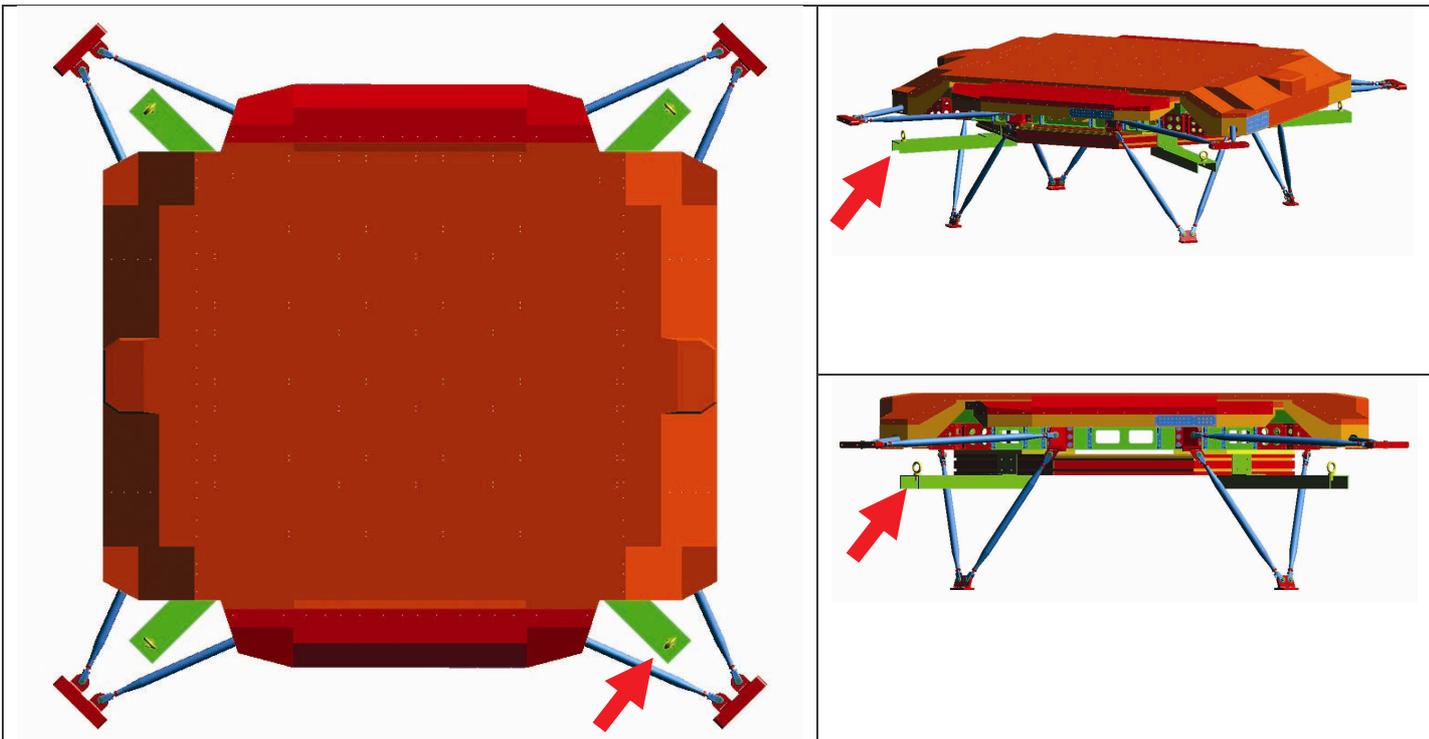


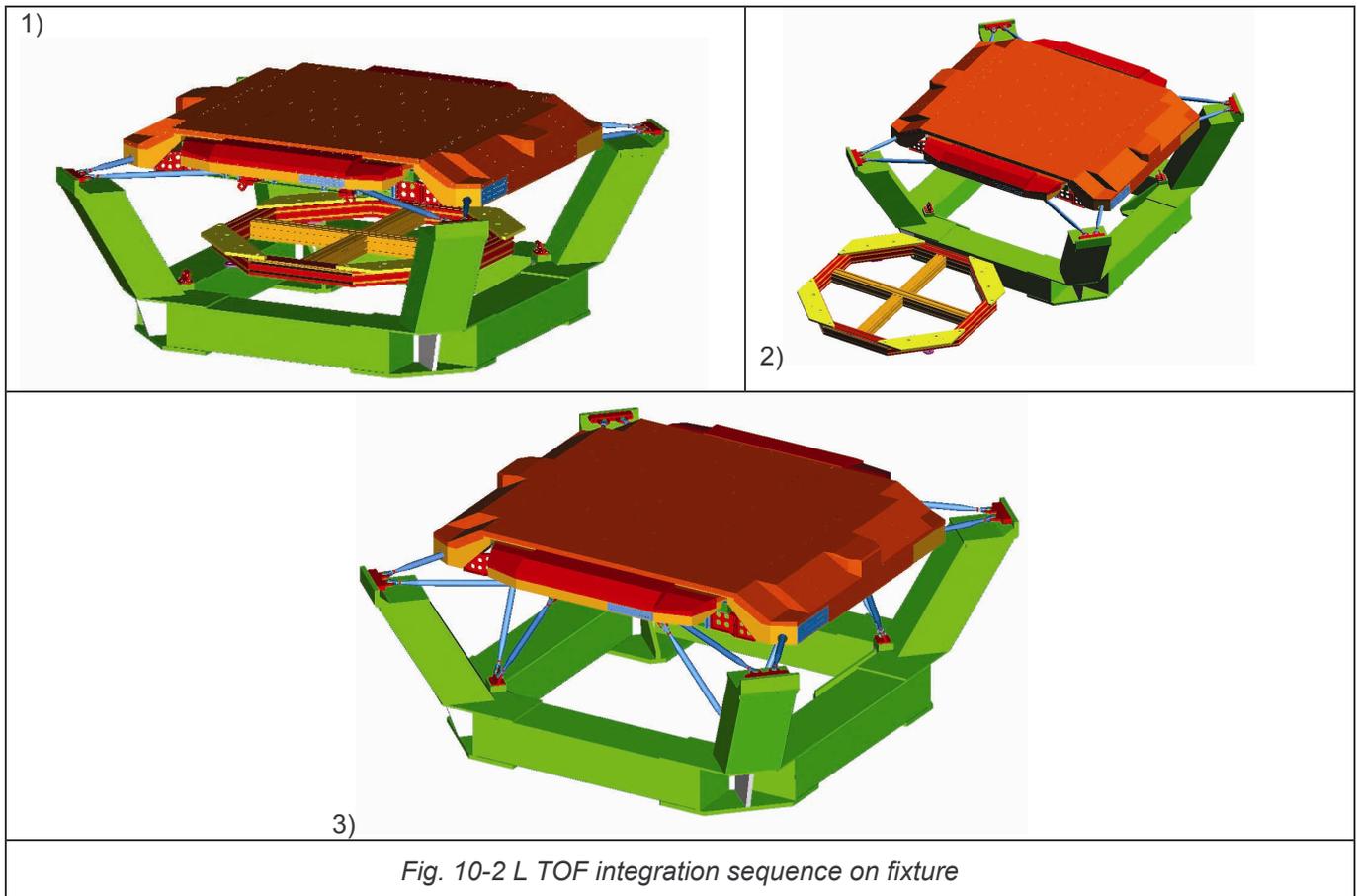
Fig. 10-1 L TOF hoisting device and hoisting points

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Then the L-TOF main part shall be positioned on the fixture with the hoisting device to allow integration of the top rods.

After that the hoisting device shall be removed (step 1,2 of next picture) and the bottom rods added (step 3 of next picture).

Preload adjustment of the rods is explained on the next chapter.



11. L-TOF RODS PRELOAD ADJUSTMENT

The LTOF rods shall be equipped with a strain gauges to adjust the rods preload.

12. TEST CONFIGURATION

Two different configuration are foreseen, one for shaker and one for sliding table:

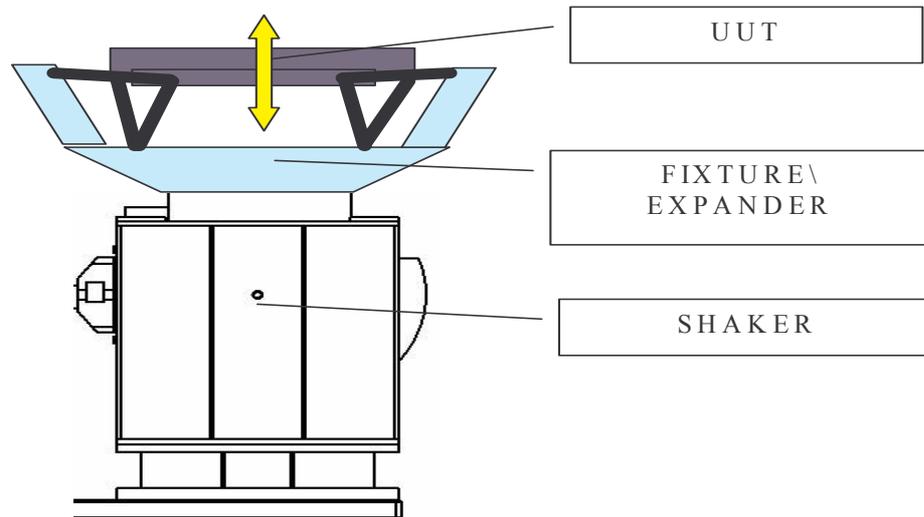


Fig. 12-1 L TOF shaker test Configuration – Z axis

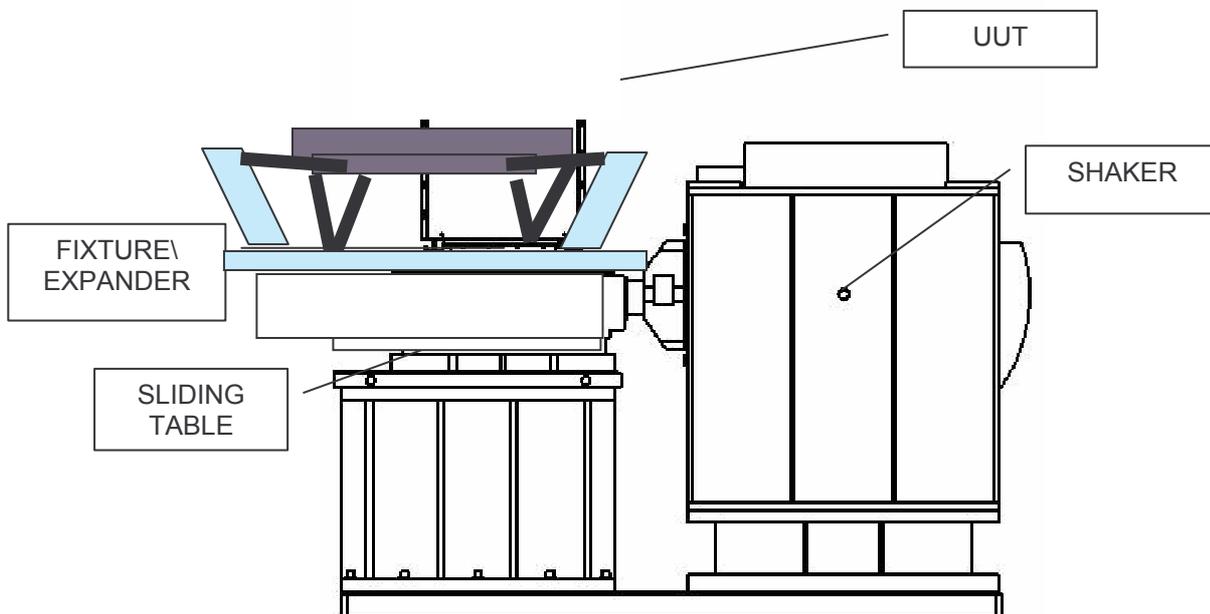


Fig. 12-2 L TOF sliding table test Configuration – X & Y axis

13. REQUIREMENTS\SUCCESS CRITERIA CROSS REFERENCE

Cross reference among requirements and procedure steps is provided in Tab. 13-1.

REQ. n°	REQUIREMENT	SUCCESS CRITERION	RESONANCE SEARCH	RANDOM LOW LEVEL	RANDOM FULL LEVEL	RESONANCE SEARCH
LTOF-RVT 1	-Lower TOF First Mode > 50 Hz (Current Predicted Mode= 50.9 Hz ,First mode is a drum mode	F1>50 Hz	X			X
LTOF-RVT 2	- Lower TOF Optional Verification for mission success (Random Vibration to MEFL UUT not degraded by applicable qualification random environment	No discrepancy on plots, no damage, loose parts or yielding		X	X	
		No frequency shift>5%, no amplitude variation > 30%				X

Tab. 13-1 Requirements cross reference



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14. FACILITY DESCRIPTION

The test shall be performed in SERMS facility:

SERMS

(laboratorio per lo Studio degli Effetti delle Radiazioni sui Materiali per lo Spazio)

Via Pentima Bassa, 21 05100 Terni

tel. +39 0744 492913

fax +39 0744 492913

14.1 SHAKER CONTROL SYSTEM

Sistema di Controllo

Spectral Dynamics

Belotti Sistemi
Via F.lli Bandiera, 8 - 20068 Peschiera Borromeo (MI)
Tel. 02.55.30.82.23 - Fax 02.55.30.31.55
E-mail: belotti.sistemi@iol.it
Web site: www.belotti-online.it
Controller: Jaguar SD 2560 - 38ch
Workstation: Sun Ultra 10
Software: Sine, Random

JAGUAR 2570 ACP 38 channel-1 output system

Mod.number: 2570-9700-2
Serial number: 2570-1268
Board: 2560-2570

Configurazione attuale 38ch di acquisizione

1 uscita drive
1 uscita COLA

Input channel

Single ended pseudo differential
10 Ω to system ground
BNC connectors

Impedenza d'ingresso >1M Ω shunt <120pF
Input coupling AC, DC, ICP

Amplificazione di ingresso programmabile:

Random, Shock, Signal Analysis 10V \pm 27mV in 3dB steps (18 ranges)

Swept Sine 10V \pm 12,5mV in 1dB steps (56 ranges)

Cross-talk fra i canali (0-20kHz) \leq -90dB

Channel matching

Ampiezza: \leq \pm 0.25 dB
Fase: \leq \pm 1° (DC \pm 20kHz)
 \leq \pm 2.5° (20kHz \pm 40kHz)

Segnale max in ingresso senza danneggiamento: \pm 35V picco

Output channel

Drive variabile
DAC 16 bit (204.8 samples/sec)
Output range 0 \pm 96 dB in 0.05 dB steps
Max output \pm 10 V picco
Impedenza d'uscita 60 Ω



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14.2 SHAKER AND SLIDING TABLE

For RV testing a 80 KN shaker and sliding table system shall be used.
The shaker and sliding table characteristics are annexed hereafter:

Vibratore Elettrodinamico

Ling Electronics, Inc.

4890 E. La Palma Ave.
Anahelm, CA 92807
Toll Free: 800-321-1781
Phone: (714)779-1900
Fax: (714)777-9173
1212E - Solid State Amplifier
C335 Vibration Exciter-modello 2016

Caratteristiche meccaniche

Carico massimo verticale	907.0 kg	8.90 kN	2000 Pounds
Carico massimo laterale	453.5 kg	4.45 kN	1000 Pounds
Carico massimo a 10g	852 kg	9.36 kN	1880 Pounds
Carico massimo a 20g	398,6 Kg	3,91 kN	880 Pounds
Carico massimo a 100g	36,24 Kg	0,356 kN	80 Pounds

Nota: tali valori sono relativi al solo shaker, per test in verticale e orizzontale; nel nostro caso il test orizzontale si differenzia dal caso precedente perchè il carico non grava più sulla testa dello shaker, la quale imprime solo il moto.

Range di frequenza effettivo di lavoro 5-3000 Hz

Frequenze Naturali

Verticale: < 3 Hz
Orizzontale: < 2 Hz

Fondamentale nominale (bare table) 2,275 Hz

Performance

Sine sweep	20000 pounds	88,8 kN peak vector
Random	16000 pounds	71 kN rms
Velocità	177,8 cm/sec	70 inch/sec
Spostamento (continuo)	38,1 mm	1,50 inch
Spostamento (shock)	51 mm	2 inch
Overtravel limitation	53,1 mm	2,1 inch
Accelerazione (bare table)	150g	



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Tavole Vibranti

Team Corporation UK Ltd.

P.O. Box 79
St. Leonard's on Sea TN37 7WX
United Kingdom
Tel: +44 (0) 1424-777004
Fax: +44 (0) 1424-777005
www.teamcorporation.com

T- Film Slip Table System 2,1x2,1m working surface
Slip Plate 1x1m working surface

Tavola grande

Dimensioni: 2,1X2,1 m;
Matrice di ancoraggio: matrice 250mm (M10X1,5) vedi schemi seguenti;
Performance: Accelerazione massima a vuoto: 7g
Range di frequenza: 5-1000 Hz

$$\text{Sine sweep: } a = \frac{20000}{2840 + \text{peso oggetto}}$$

$$\text{Random: } a = \frac{16000 \text{ (lb)}}{2840 + \text{peso oggetto}}$$

nota: il valore di 2840 lb è comprensivo del peso della tavola, sommato a quello della travel-bare interna allo shaker e del giunto di ancoraggio tra shaker e tavola;

Tavola piccola

Dimensioni: 1X1 m;
Matrice di ancoraggio: matrice 250mm (M10X1,5) vedi schemi seguenti;
Performance: Accelerazione massima a vuoto: 22,8g
Range di frequenza: 5-2000 Hz

$$a = \frac{20000}{875 + \text{peso oggetto}}$$

nota: il valore di 2840 lb è comprensivo del peso della tavola, sommato a quello della travel-bare interna allo shaker e del giunto di ancoraggio tra shaker e tavola;

14.3 DATA EVALUATION

The facility shall provide after each test run the frequency dependent data in printed form to allow data evaluation. Under request it will be possible to compare plots from different runs on monitor and print the compared curves before to proceed to the next run



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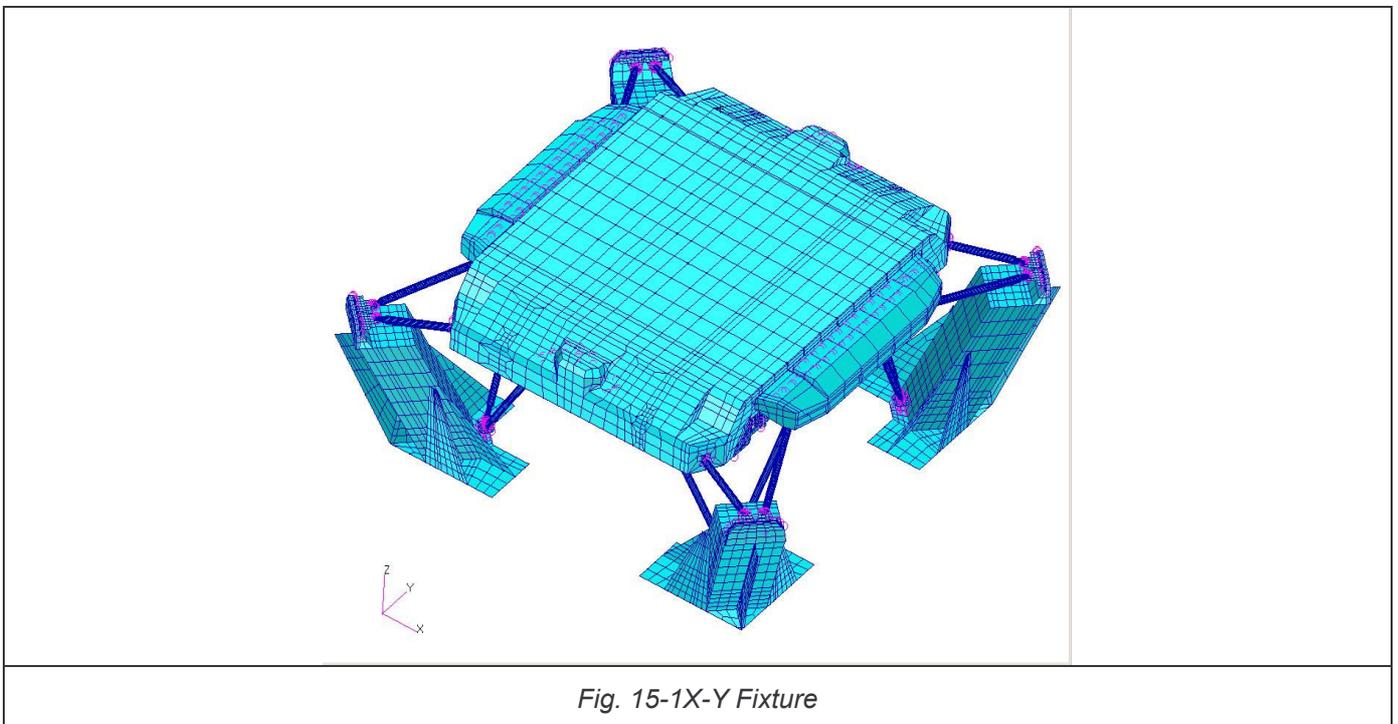
15. TEST FIXTURE

15.1 FIXTURE DESIGN

Fixture manufactured by SERMS facility shall provide a fixation patterns to the facility equipment and to the UUT. The fixture dynamic behavior shall guarantee:

- Successfull identification of the first resonance search of the L-TOF.
- Control the vibration levels at UUT interface within the required tolerances.
- The fixture shall be able to withstand all the applicable integration and test loads.

Two different fixtures shall be used, one for in plane (X-Y) vibration and one (Z) vibration In the following figure the fixtures are showed.





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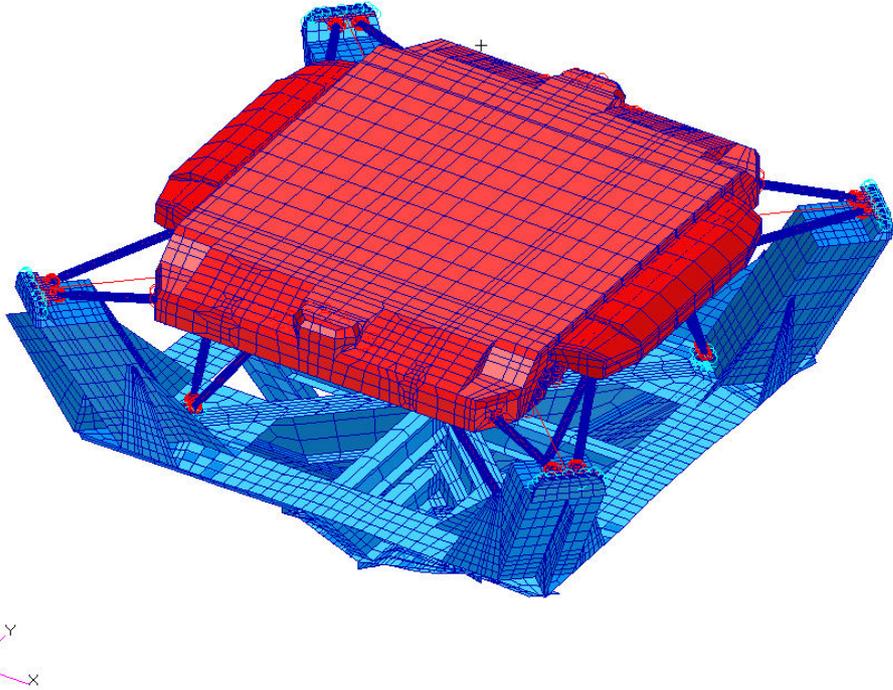


Fig. 15-2 Z Fixture

Fixture material is aluminum and Steel

The following bolts shall be used for installation :

JOINT	BOLT TYPE	TORQUE
Fixture to expander or sliding table	TBD by SERMS	TBD by SERMS
UUT\fixture on top interfaces (ref RD1 pag 85)	NAS1351-6 A286-160 KSI	60Nm +/-10%
UUT\fixture on bottom interfaces with (ref RD1 pag 88)	NAS1351-4 A286-160 KSI	17Nm +/-10%

Tab. 15-1 INSTALLATION BOLTS AND TORQUES

X-Y FIXTURE MASS BUDGET	
ITEM	Estimated weight [kg]
TOTAL	153
Z FIXTURE MASS BUDGET	
ITEM	Estimated weight [kg]
TOTAL	905

Tab. 15-2 FIXTURE Mass budget (LTOF not included)

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15.2 FIXTURE TEST RESULTS

A set of test results of the fixtures alone shall be provided by SERM before the workmanship test to verify the correctness and update if needed the model used for the predictions of RD2.
The results shall be in form of frequency response functions between the shaker\sliding table interface and the fixture most relevant locations for the test purposes.

16. ACCELEROMETERS

The used accelerometers are type KS94.100/KS95.100 for control and KS94\KS95 for measure. The accelerometers datasheet and calibration status shall be annexed to the test report.
The accelerometers shall be placed using proper mounting adapters and means of mounting (adhesive strips or glue) able to guarantee an accurate measurement in the range 5-2000 Hz.
The accelerometers of the Flight hardware shall be placed using proper mounting adapters and means of mounting (adhesive strips or glue) without causing surface treatment\parts damage or modification. Any modification of the UUT for accelerometers placement must be previously agreed with the UUT responsible\.

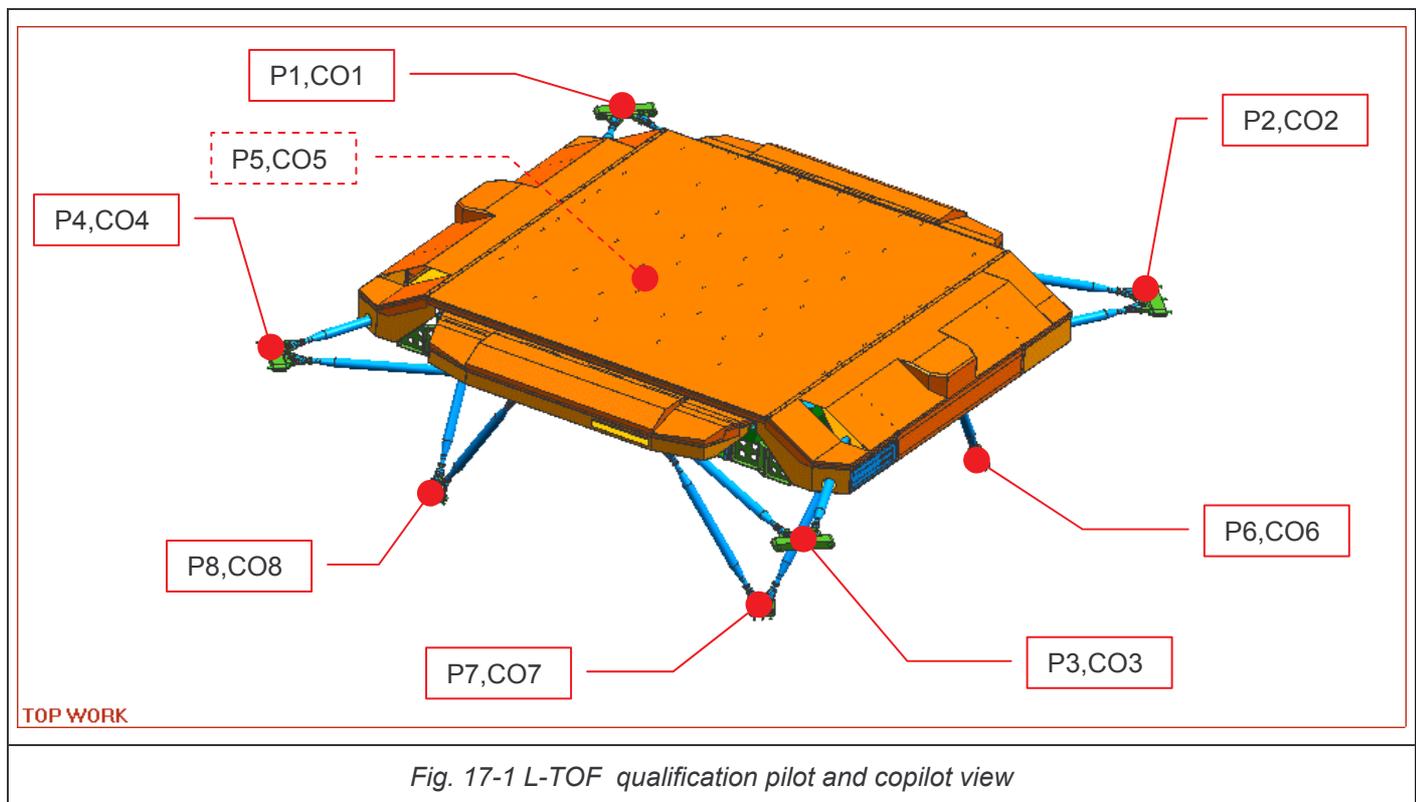
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17. INSTRUMENTATION PLAN

17.1 ACCELEROMETERS

The measurement accelerometers shall be placed in the locations defined hereafter:

Some accelerometers shall be placed inside the L-TOF, closing the PMT covers only with screws. After the vibration test the covers shall be removed, the accelerometers shall be removed, and then the covers shall be closed permanently with screws and epoxy. The next pictures show the open covers and the accelerometers locations:





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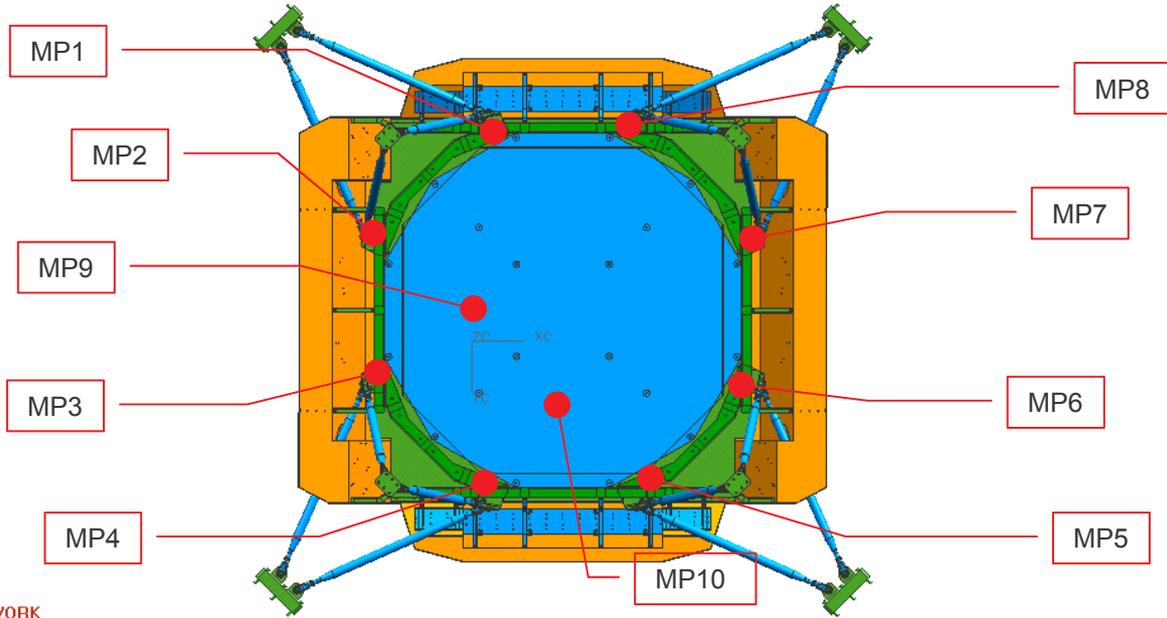


Fig. 17-2 L-TOF qualification measurement points view

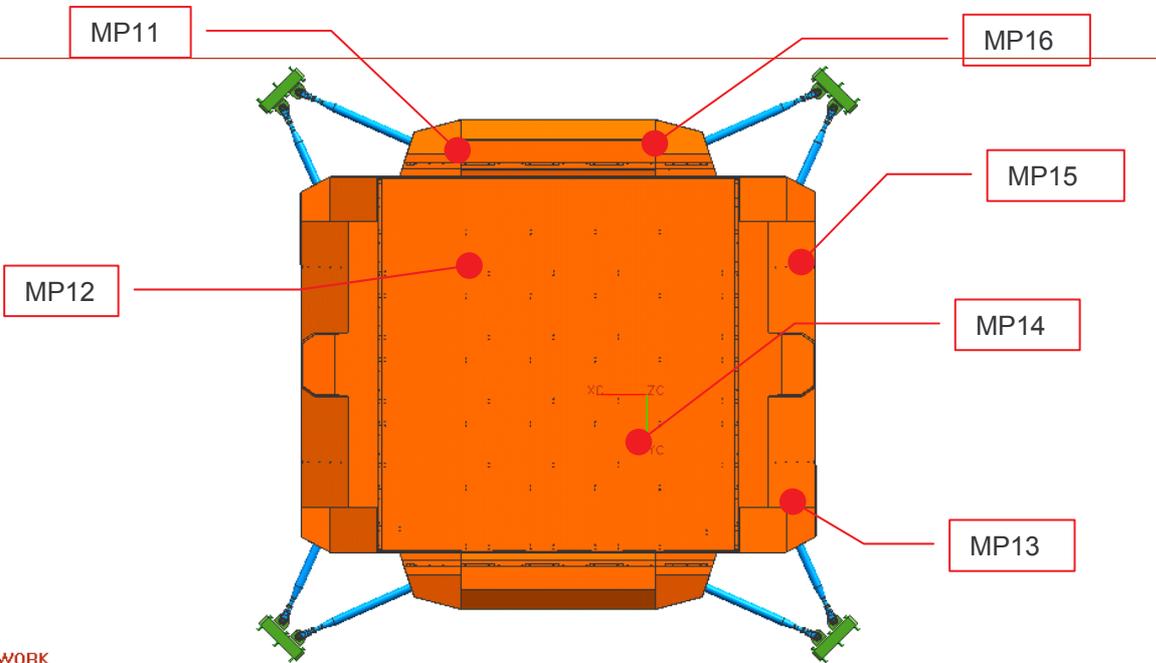


Fig. 17-3 L-TOF qualification measurement points view



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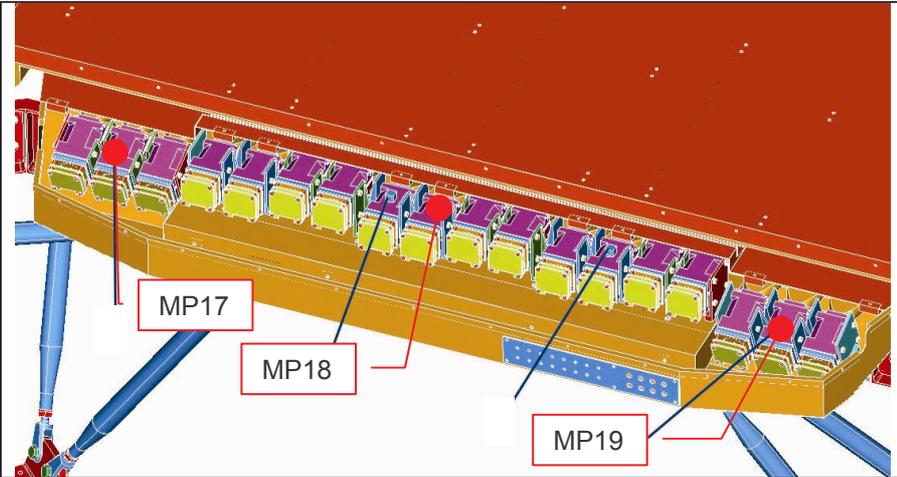


Fig. 17-4 L-TOF qualification internal measurement points view

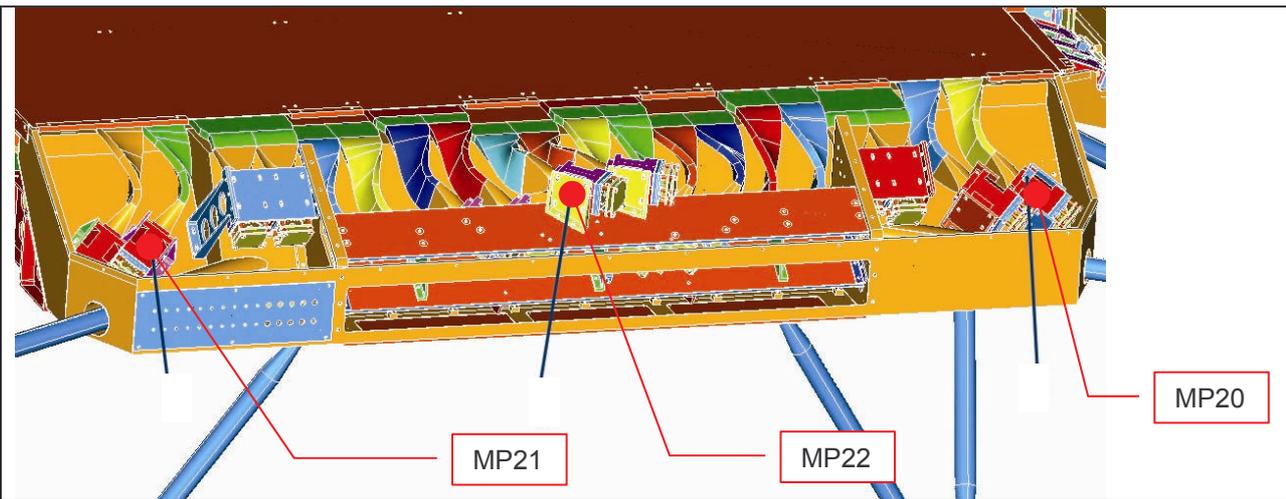


Fig. 17-5 L-TOF qualification internal measurement points view



Fig. 17-6 L-TOF qualification internal measurement points view



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SENSOR	LOCATION DESCRIPTION	SENSITIVITY AXIS	REMARKS*	CHANNELS	ACCELEROMETER TYPE
P 1	L-TOF IF-1	Excited axis	Pilot	1	KS94.100/KS95.100 (SERMS)
P 2	L-TOF IF-2	Excited axis	Pilot	1	KS94.100/KS95.100 (SERMS)
P 3	L-TOF IF-3	Excited axis	Pilot	1	KS94.100/KS95.100 (SERMS)
P 4	L-TOF IF-4	Excited axis	Pilot	1	KS94.100/KS95.100 (SERMS)
P 5	L-TOF IF-5	Excited axis	Pilot	1	KS94.100/KS95.100 (SERMS)
P 6	L-TOF IF-6	Excited axis	Pilot	1	KS94.100/KS95.100 (SERMS)
P 7	L-TOF IF-7	Excited axis	Pilot	1	KS94.100/KS95.100 (SERMS)
P 8	L-TOF IF-8	Excited axis	Pilot	1	KS94.100/KS95.100 (SERMS)
CO 1	L-TOF IF-1	non exc axes	CoPilot	2	KS94\KS95 (SERMS)
CO 2	L-TOF IF-2	non exc axes	CoPilot	2	KS94\KS95 (SERMS)
CO 3	L-TOF IF-3	non exc axes	CoPilot	2	KS94\KS95 (SERMS)
CO 4	L-TOF IF-4	non exc axes	CoPilot	2	KS94\KS95 (SERMS)
CO 5	L-TOF IF-5	non exc axes	CoPilot	2	KS94\KS95 (SERMS)
CO 6	L-TOF IF-6	non exc axes	CoPilot	2	KS94\KS95 (SERMS)
CO 7	L-TOF IF-7	non exc axes	CoPilot	2	KS94\KS95 (SERMS)
CO 8	L-TOF IF-8	non exc axes	CoPilot	2	KS94\KS95 (SERMS)
CP 1	L-TOF LEG 1	X, Y, Z	Measure str	3	KS94\KS95 (SERMS)
CP 2	L-TOF LEG 2	X, Y, Z	Measure str	3	KS94\KS95 (SERMS)
CP 3	L-TOF LEG 3	X, Y, Z	Measure str	3	KS94\KS95 (SERMS)
CP 4	L-TOF LEG 4	X, Y, Z	Measure str	3	KS94\KS95 (SERMS)
CP 5	L-TOF LEG 5	X, Y, Z	Measure str	3	KS94\KS95 (SERMS)
CP 6	L-TOF LEG 6	X, Y, Z	Measure str	3	KS94\KS95 (SERMS)
CP 7	L-TOF LEG 7	X, Y, Z	Measure str	3	KS94\KS95 (SERMS)
CP 8	L-TOF LEG 8	X, Y, Z	Measure str	3	KS94\KS95 (SERMS)
CP 9	L-TOF AG 1	X, Y, Z	Measure str	3	KS94\KS95 (SERMS)
CP 10	L-TOF AG 2	X, Y, Z	Measure str	3	KS94\KS95 (SERMS)
CP 11	L-TOF EXX 1	X, Y, Z	Measure str	3	KS94\KS95 (SERMS)
CP 12	L-TOF EXX 2	X, Y, Z	Measure str	3	KS94\KS95 (SERMS)
CP 13	L-TOF EXX 3	X, Y, Z	Measure str	3	KS94\KS95 (SERMS)
CP 14	L-TOF EXX 4	X, Y, Z	Measure str	3	KS94\KS95 (SERMS)
CP 15	L-TOF EYY 1	X, Y, Z	Measure str	3	KS94\KS95 (SERMS)
CP 16	L-TOF EYY 2	X, Y, Z	Measure str	3	KS94\KS95 (SERMS)
CP 17	TBD	TBD	Measure electr	3	KS94\KS95\KS943 (SERMS) **
CP 18	TBD	TBD	Measure electr	3	KS94\KS95\KS943 (SERMS) **
CP 19	TBD	TBD	Measure electr	3	KS94\KS95\KS943 (SERMS) **
CP 20	TBD	TBD	Measure electr	3	KS94\KS95\KS943 (SERMS) **
CP 21	TBD	TBD	Measure electr	3	KS94\KS95\KS943 (SERMS) **
CP 22	TBD	TBD	Measure electr	3	KS94\KS95\KS943 (SERMS) **
CP 23	TBD	TBD	Measure electr	3	KS94\KS95\KS943 (SERMS) **
CP 24	TBD	TBD	Measure electr	3	KS94\KS95\KS943 (SERMS) **
CP 25	TBD	TBD	Measure electr	2	KS94\KS95\KS943 (SERMS) **
	AVAILABLE	98	CURRENT	98	

*Pilot= control signal
CoPilot=monitoring of cross axes
Measure str.=measure of structure response
Measure electr.=measure of internal minor items
**Only four KS943 available

Tab. 6-1 Measurement points table

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17.2 STRAIN GAUGES

For each LTOF rod one strain gauge (total of 16 strain gauges) shall be mounted and connected to a readout instrument during integration to monitor the rods preload.

During test 8 strain gauges shall be connected to DAS to measure the rod forces during test.

18. INSTRUMENTATION, SPECIAL TOOLS AND TEST EQUIPMENT

The complete list of the instrumentation used during the test shall be recorded in Tab. 18-1.

The list shall be filled up during tests and reported in Test Report.

This list can be replaced by a "Declaration of Facility and Test Readiness", which summarizes the used test and measurement equipment in tabular form. The same declaration, including calibration and maintenance data, is later part of the finally summary test report.

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19. TEST LEVELS

19.1 RESONANCE SEARCH LEVELS

During resonance search the following level shall be used:

Linear frequency scan band:	5-2000 Hz
Scan speed	2 oct/min (sweep up only)
Level:	0.3 g (peak)
Control:	Multipoint input control is used with maximum strategy

Tab. 19-1 Resonance search level

19.2 RANDOM VIBRATION LEVELS

The proposed baseline levels already exceed the allowable PMT limits according to the analytical predictions. Those levels shall be considered therefore a baseline on which to apply the notching criteria, as soon as the results of the first resonance search shall confirm the analytical predictions.



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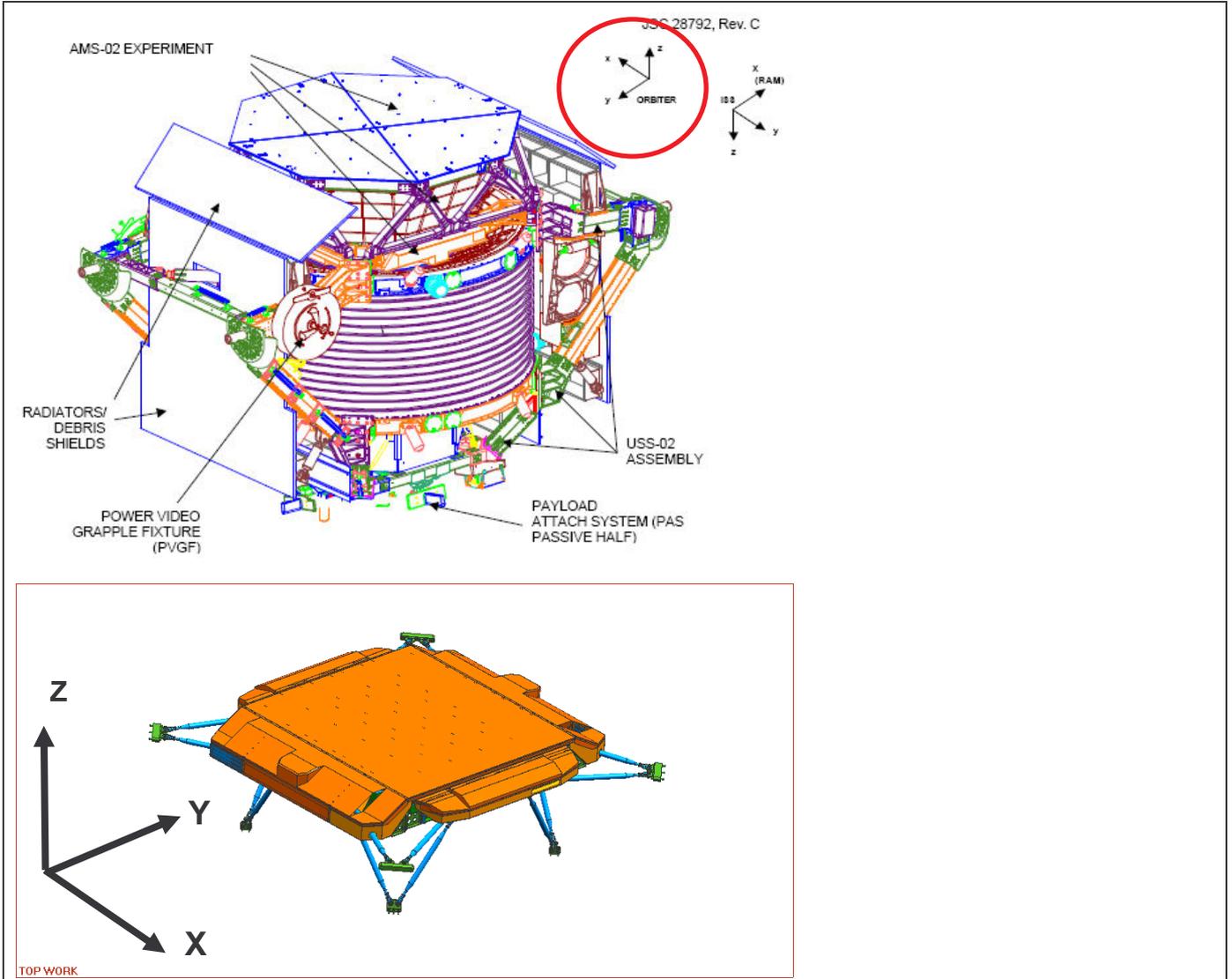
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Tab. 19-2 LTOF TEST AXES AND AD1 AXES



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Table 15-1: Maximum Expected Flight Levels for AMS-02

X Axis	20-58 Hz	0.0025 g ² /Hz
	58-125 Hz	+9 dB/Octave
	125-300 Hz	0.025 g ² /Hz
	300-900 Hz	-9 dB/Octave
	900-2000 Hz	0.001 g ² /Hz
	Overall = 3.1 Grms	
Y Axis	20-90 Hz	0.008 g ² /Hz
	90-100 Hz	+9 dB/Octave
	100-300 Hz	0.01 g ² /Hz
	300-650 Hz	-9 dB/Octave
	650-2000 Hz	0.001 g ² /Hz
	Overall = 2.3 Grms	
Z Axis	20-45 Hz	0.009 g ² /Hz
	45-125 Hz	+3 dB/Octave
	125-300 Hz	0.025 g ² /Hz
	300-900 Hz	-9 dB/Octave
	900-2000 Hz	0.001 g ² /Hz
	Overall = 3.2 Grms	

Note: MEFL Test duration: 60 seconds per axis

Tab. 19-3 LTOF MEFL Random spectrum FROM AD1

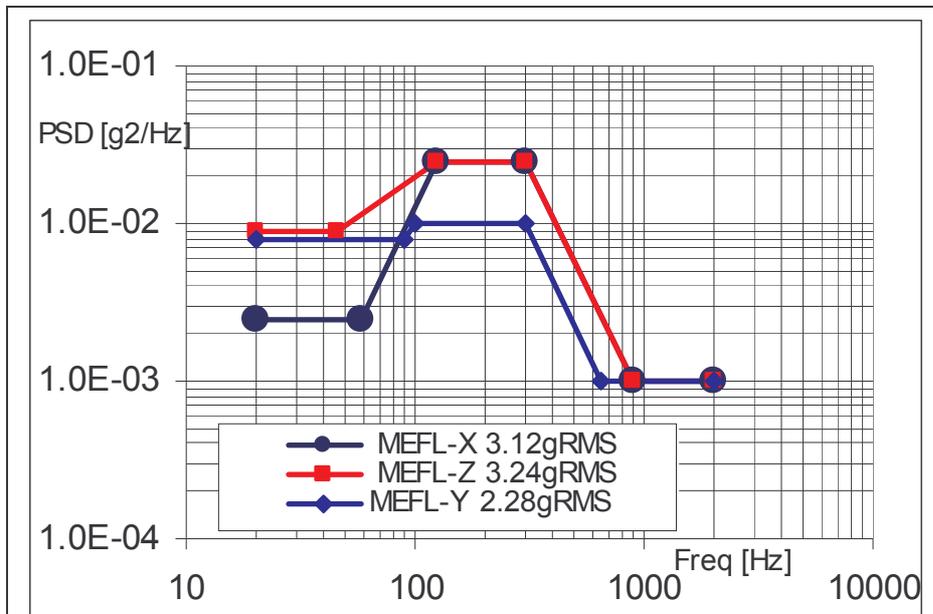


Fig. 19-1 LTOF MEFL Random spectrum FROM AD1

20. TEST PREDICTIONS AND NOTCHING APPROACH

Test predictions and notching approach is detailed in RD 2. In the following chapter a summary of the performed analyses and results is provided for test execution.

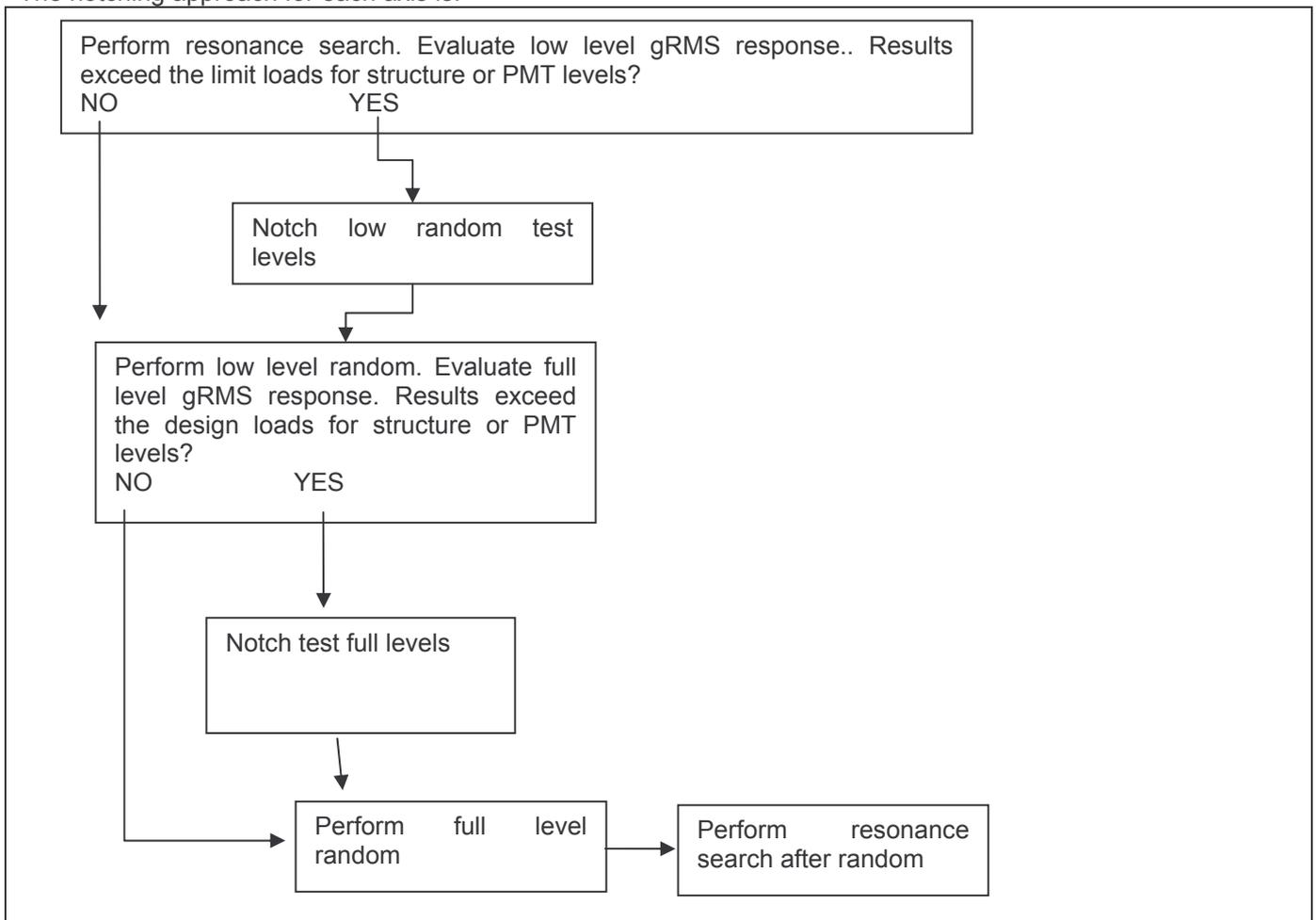
Notching shall be based both on analytical predictions and the measurements available during test. Notched levels and rationale used to derive them shall be recorded in a PVS datasheet.

20.1 NOTCHING PHILOSOPHY

During test if required, and according to the test predictions of RD2 a notching shall be implemented for the following scope:

1. not to exceed structural stress/force design levels
2. not to exceed at critical components level (PMT) their qualification levels.

The notching approach for each axis is:



Tab. 20-1: notching logic flowchart RD1

Notched levels and rationale shall be recorded in a PVS datasheet.

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20.2 NOTCHING FOR STRENGHT PURPOSES

For each run the gRMS response measured on the most representative point on the LTOF ring structure shall be used and multiplied by the ratio COGMP to evaluate the real acceleration at CoG during test:

According ro RD2 , in case the calculated equivalent static test loads is exceeding the limit of 12gRMS(3sigma) a notching has to be evaluated to avoid structure overtesting.

Based on the predictions of RD2 anyway no notching should be required for this purpose, considering the MEFL levels.

20.3 NOTCHING FOR COMPONENTS SPECIFICATION

Monitored components are the PMT's . Those components are qualified for a 6.8 gRMS 1sigma level. Therefore the input level shall be notched to guarantee that the measured channels shall not exceed this limit.

Based on the predictions of RD2 anyway notching should be required for this purpose especially in Z and Y direction.

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21. TEST CONDITIONS

- The UUT shall be mounted on the vibrator exciter by bolting to the fixture.
- The transmissibility characteristic of the rigid fixture will guarantee that the input vibration levels are transmitted from the exciter to the UUT.
- Unless otherwise specified, all the measurements are to be performed at the following ambient conditions:
 - Temperature : 20°C ± 5°C
 - Relative humidity : 60% ± 20% RH
 - Pressure : Ambient
 - Cleanliness : visibly clean class
- Laboratories General disposition shall be applied to maximize personnel safety from potential hazards.
- Skilled personnel shall be employed.
- All used instruments shall meet the necessary tolerances and shall not degrade the UUT performance:
 - for resonance search
 - Frequency : ± 2%
 - Sweep rate : ± 5%
 - Amplitude : ± 10%
 - for random vibration
 - Frequency : ± 5% (or 1 Hz whichever is greater)
 - PSD : -1/+3 dB
 - Overall g_{RMS} : ± 10%
- The accuracy of all the instruments shall be consistent with the tolerances for the variable to be measured, and should be at least one third of the tolerance itself.

22. TEST PROCEDURE VARIATION SHEET

In case that for any reason the test procedure has to be changed, the change shall be described in a Procedure Variation Sheet (PVS) as shown in the next page.

The PVS shall contain:

- Reference to the test procedure to be changed
- Reference to the relevant test, procedure page and paragraph
- Description of the change, possibly in the form was....is.....
- Reason for change
- Test Engineer, and Test conductor signatures and dates

Each PVS shall be identified by a reference number provided in sequential order.

All the generated PVS shall be collected in a dedicated section of the Test Report.

 CARLO GAVAZZI CARLO GAVAZZI SPACE SpA	<h1>AMS-02</h1>	N° Doc: RICHSYS-PR-CGS-0013 Doc N°:	
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23. TEST DATA SHEETS

The step-by-step procedure sheets are provided in the following pages.

23.1 DATA SHEETS FILLING UP

The following fields of the data sheets:

- UUT DATA (including Model, Item, C.I., S/N)
- Measured value

Shall be filled up during the test performances and shall be part of the Test Report together with photographs, sketches, etc. eventually useful to document the test execution/result.

Remarks field shall be used as a minimum to provide, where appropriate, reference to PVS.

Test Report reference data shall be added in the relevant field.

Each data sheet (including the attachments) shall be certified with the Test Conductor signature and date.

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TEST PROCEDURE REFERENCE		TEST REPORT REFERENCE	

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
1.	LTOF TEST SETUP			
1.1.	REMOVE L-TOF FROM TRANSPORT CONTAINER	ok		
1.2.	INSTALL INTERNAL ACCELEROMETERS	ok		
1.3.	INSTALL EXTERNAL ACCELEROMETERS	ok		
1.4.	INSTALL LTOF RODS AND STRAINGAUGES	ok		

UUT DATA :	Model	FM	Item	MESBAH SATELLITE ASSY	C.I.	S/N	FM01
------------	-------	----	------	-----------------------	------	-----	------

DATE:	TEST CONDUCTOR	QA	CUSTOMER
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TEST PROCEDURE REFERENCE		TEST REPORT REFERENCE			

UUT DATA :	Model	FM	Item	MESBAH SATELLITE ASSY	C.I.	S/N	FM01
STEP n°	TEST SEQUENCE		EXPECTED VALUE	MEASURED VALUE	REMARKS		

2.	TEST X AXIS				
2.1.	UNLOADED FIXTURE RESONANCE SEARCH				
2.1.1.	INSTALL FIXTURE ON SHAKER				
2.1.2.	FIX CONTROL ACCELEROMETERS TO FIXTURE		OK		
2.1.3.	PROGRAM SHAKER ACCORDING TO Tab. 19-1 AND PERFORM RESONANCE SEARCH		OK		
2.1.4.	VERIFY PLOTS		Cross talk ok Amplifdegr .ok pilot and copilot ok		
2.1.5.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE		OK		

DATE:	TEST CONDUCTOR	QA	CUSTOMER
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UUT DATA :	Model	FM	Item	MESBAH SATELLITE ASSY	C.I.	S/N	FM01
STEP n°	TEST SEQUENCE		EXPECTED VALUE	MEASURED VALUE	REMARKS		

2.2.	RESONANCE SEARCH BEFORE RANDOM LOW LEVEL			
2.2.1.	INSTALL UUT TO THE FIXTURE FOR X DIRECTION VIBRATION			
2.2.2.	CONNECT MEASURE ACCELEROMETERS TO DAS	OK		
2.2.3.	PROGRAM SHAKER ACCORDING TO Tab. 19-1 AND PERFORM RESONANCE SEARCH	OK		
2.2.4.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
2.2.5.	FREQUENCY IDENTIFICATION AND EVALUATION OF PLOTS	F ₁ > 50 Hz		

DATE:	TEST CONDUCTOR	QA
		CUSTOMER

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TEST PROCEDURE REFERENCE		TEST REPORT REFERENCE	

UUT DATA :	Model	FM	C.I.
	Item	MESBAH SATELLITE ASSY	S/N FM01
STEP n°	TEST SEQUENCE		REMARKS

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
2.4.	FULL LEVEL RANDOM			
2.4.1.	PROGRAM SHAKER ACCORDING TO CHP 19.2 FULL LEVEL -0dB	OK		
2.4.2.	PERFORM RANDOM VIBRATION	OK		
2.4.3.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
2.4.4.	VERIFY PLOTS	No deformation No damage No loose parts No discrepancy wrt previous plots		
2.4.5.	VERIFY COG ACCELERATION AND NOTCHING	OK		
2.4.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING	OK		

DATE:	TEST CONDUCTOR	QA	CUSTOMER
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		TEST PROCEDURE REFERENCE	TEST REPORT REFERENCE		

UUT DATA :	Model	FM	Item	MESBAH SATELLITE ASSY	C.I.	S/N	FM01
STEP n°	TEST SEQUENCE						

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
2.5.	RESONANCE SEARCH AFTER FULL LEVEL RANDOM			
2.5.1.	PROGRAM SHAKER ACCORDING TO Tab. 19-1 AND PERFORM RESONANCE SEARCH	OK		
2.5.2.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
2.5.3.	VERIFY PLOTS	freq shift ok amplif var. ok		
2.5.4.	CHECK INTERFACE BOLTS TORQUE	OK		
2.5.5.	REMOVE UUT FROM FIXTURE	OK		
2.5.6.	REMOVE FIXTURE	OK		

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		CUSTOMER

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TEST PROCEDURE REFERENCE		TEST REPORT REFERENCE	

UUT DATA :	Model	FM	Item	MESBAH SATELLITE ASSY	C.I.	S/N	FM01
STEP n°	TEST SEQUENCE		EXPECTED VALUE	MEASURED VALUE	REMARKS		

3.	TEST Y AXIS			
3.1.	UNLOADED FIXTURE RESONANCE SEARCH			
3.1.1.	INSTALL FIXTURE ON SHAKER		OK	
3.1.2.	FIX CONTROL ACCELEROMETERS TO FIXTURE		OK	
3.1.3.	PROGRAM SHAKER ACCORDING TO Tab. 19-1 AND PERFORM RESONANCE SEARCH		OK	
3.1.4.	VERIFY PLOTS		Cross talk ok Amplifdegr .ok pilot and copilot ok	
3.1.5.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE		OK	

DATE:	TEST CONDUCTOR	QA	CUSTOMER
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UUT DATA :	Model	Item	C.I.
	FM	MESBAH SATELLITE ASSY	
STEP n°	TEST SEQUENCE		REMARKS

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
3.2.	RESONANCE SEARCH BEFORE RANDOM LOW LEVEL			
3.2.1.	INSTALL UUT TO THE FIXTURE FOR X DIRECTION VIBRATION			
3.2.2.	CONNECT MEASURE ACCELEROMETERS TO DAS	OK		
3.2.3.	PROGRAM SHAKER ACCORDING TO Tab. 19-1 AND PERFORM RESONANCE SEARCH	OK		
3.2.4.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
3.2.5.	FREQUENCY IDENTIFICATION AND EVALUATION OF PLOTS	F ₁ > 50 Hz		

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	L-TOF VIBRATION TEST PROCEDURE		Ediz.: Issue: 1	Ediz.: Issue: 1
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			di of: 52	di of:
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			TEST REPORT REFERENCE	

UUT DATA :		Model	FM	Item	MESBAH SATELLITE ASSY	C.I.	S/N	FM01
STEP n°	TEST SEQUENCE		EXPECTED VALUE	MEASURED VALUE	REMARKS			

3.3.	LOW LEVEL RANDOM							
3.3.1.	PROGRAM SHAKER ACCORDING TO CHP 19.2 LOW LEVEL (-6 Db)		OK					
3.3.2.	PERFORM RANDOM VIBRATION		OK					
3.3.3.	ANNEX TO THE TEST REPORT RESPONSE FROM THE MPs AND SAVE FILE		OK					
3.3.4.	VERIFY PLOTS		No deformation No damage No loose parts No discrepancy wrt previous plots					
3.3.5.	VERIFY COG ACCELERATION AND NOTCHING		OK					
3.3.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING		OK					

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		TEST PROCEDURE REFERENCE	TEST REPORT REFERENCE					

UUT DATA :	Model	FM	Item	MESBAH SATELLITE ASSY	C.I.	S/N	FM01	
STEP n°	TEST SEQUENCE					EXPECTED VALUE	MEASURED VALUE	REMARKS

3.4.	FULL LEVEL RANDOM						
3.4.1.	PROGRAM SHAKER ACCORDING TO CHP 19.2 FULL LEVEL -0dB			OK			
3.4.2.	PERFORM RANDOM VIBRATION			OK			
3.4.3.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE			OK			
3.4.4.	VERIFY PLOTS			No deformation No damage No loose parts No discrepancy wrt previous plots			
3.4.5.	VERIFY COG ACCELERATION AND NOTCHING			OK			
3.4.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING			OK			

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		TEST PROCEDURE REFERENCE	TEST REPORT REFERENCE		

UUT DATA :	Model	FM	Item	MESBAH SATELLITE ASSY	C.I.	S/N	FM01
STEP n°	TEST SEQUENCE						

	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
3.5.	RESONANCE SEARCH AFTER FULL LEVEL RANDOM			
3.5.1.	PROGRAM SHAKER ACCORDING TO Tab. 19-1 AND PERFORM RESONANCE SEARCH	OK		
3.5.2.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
3.5.3.	VERIFY PLOTS	freq shift ok amplif var. ok		
3.5.4.	CHECK INTERFACE BOLTS TORQUE	OK		
3.5.5.	REMOVE UUT FROM FIXTURE	OK		
3.5.6.	REMOVE FIXTURE	OK		

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		CUSTOMER

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UUT DATA :	Model	FM	C.I.
	Item	MESBAH SATELLITE ASSY	S/N FM01
STEP n°	TEST SEQUENCE		REMARKS

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
4.	TEST Z AXIS			
4.1.	UNLOADED FIXTURE RESONANCE SEARCH			
4.1.1.	INSTALL FIXTURE ON SHAKER	OK		
4.1.2.	FIX CONTROL ACCELEROMETERS TO FIXTURE	OK		
4.1.3.	PROGRAM SHAKER ACCORDING TO Tab. 19-1 AND PERFORM RESONANCE SEARCH	OK		
4.1.4.	VERIFY PLOTS	Cross talk ok Amplifdegr .ok pilot and copilot ok		
4.1.5.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		

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UUT DATA :	Model	Item	C.I.
	FM	MESBAH SATELLITE ASSY	
STEP n°	TEST SEQUENCE		REMARKS

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
4.2.	RESONANCE SEARCH BEFORE RANDOM LOW LEVEL			
4.2.1.	INSTALL UUT TO THE FIXTURE FOR X DIRECTION VIBRATION			
4.2.2.	CONNECT MEASURE ACCELEROMETERS TO DAS	OK		
4.2.3.	PROGRAM SHAKER ACCORDING TO Tab. 19-1 AND PERFORM RESONANCE SEARCH	OK		
4.2.4.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
4.2.5.	FREQUENCY IDENTIFICATION AND EVALUATION OF PLOTS	F ₁ > 50 Hz		

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UUT DATA :	Model	FM	Item	MESBAH SATELLITE ASSY	C.I.	S/N	FM01
STEP n°	TEST SEQUENCE			EXPECTED VALUE	MEASURED VALUE	REMARKS	

	4.3.	LOW LEVEL RANDOM				
	4.3.1.	PROGRAM SHAKER ACCORDING TO CHP 19.2 LOW LEVEL (-6 Db)	OK			
	4.3.2.	PERFORM RANDOM VIBRATION	OK			
	4.3.3.	ANNEX TO THE TEST REPORT RESPONSE FROM THE MPs AND SAVE FILE	OK			
	4.3.4.	VERIFY PLOTS	No deformation No damage No loose parts No discrepancy wrt previous plots			
	4.3.5.	VERIFY COG ACCELERATION AND NOTCHING	OK			
	4.3.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING	OK			

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UUT DATA :	Model	FM	Item	MESBAH SATELLITE ASSY	C.I.	S/N	FM01
STEP n°	TEST SEQUENCE			EXPECTED VALUE	MEASURED VALUE	REMARKS	

4.4.	FULL LEVEL RANDOM	OK		
4.4.1.	PROGRAM SHAKER ACCORDING TO CHP 19.2 FULL LEVEL -0dB	OK		
4.4.2.	PERFORM RANDOM VIBRATION	OK		
4.4.3.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
4.4.4.	VERIFY PLOTS	No deformation No damage No loose parts No discrepancy wrt previous plots		
4.4.5.	VERIFY COG ACCELERATION AND NOTCHING	OK		
4.4.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING	OK		

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UUT DATA :	Model	FM	Item	MESBAH SATELLITE ASSY	C.I.	S/N	FM01
STEP n°	TEST SEQUENCE			EXPECTED VALUE	MEASURED VALUE	REMARKS	

4.5.	RESONANCE SEARCH AFTER FULL LEVEL RANDOM				
4.5.1.	PROGRAM SHAKER ACCORDING TO Tab. 19-1 AND PERFORM RESONANCE SEARCH	OK			
4.5.2.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK			
4.5.3.	VERIFY PLOTS	freq shift ok amplif var. ok			
4.5.4.	CHECK INTERFACE BOLTS TORQUE	OK			
4.5.5.	REMOVE UUT FROM FIXTURE	OK			
4.5.6.	REMOVE FIXTURE	OK			

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UUT DATA :	Model	FM	C.I.
	Item	MESBAH SATELLITE ASSY	
STEP n°	TEST SEQUENCE		REMARKS

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
5.	TEST SETUP DISMANTLING			
5.1.	REMOVE FROM L-TOF THE INTERNAL AND EXTERNAL ACCELEROMETERS	OK		
5.2.	INSERT L-TOF ON TRANSPORT CONTAINER READY FOR SHIPMENT	OK		

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